OFFICE OF ENERGY RESEARCH

The Office of Energy Research advances the science and technology foundation for the Department and the Nation to achieve efficiency in energy use, diverse and reliable energy sources, a productive and competitive economy, improved health and environmental quality, and a fundamental understanding of matter and energy. The Director of Energy Research is responsible for six major outlay programs: Basic Energy Sciences, Fusion Energy, Health and Environmental Research, High Energy and Nuclear Physics, Superconducting Supercollider, and Scientific Computing. The Director also advises the Secretary on DOE physical research programs, university-based education and training activities, grants, and other forms of financial assistance.

The Office of Energy Research conducts materials research in the following offices and divisions:

- Office of Basic Energy Sciences - Division of Engineering and Geosciences; Division of Materials Sciences; and Division of Chemical Sciences
- Office of Computational and Technology Research - Division of Physical and Technology Research
- Office of Health and Environmental Research - Division of Physical and Technology Research
- Office of Fusion Energy - Division of Advanced Physics and Technology

Materials research is carried out through the DOE national laboratories, other federal laboratories, and grants to universities and industry.

OFFICE OF BASIC ENERGY SCIENCES

The Office of Basic Energy Sciences supports research to advance the scientific and technical knowledge and skills needed to develop and use new and existing energy resources in an economically viable and environmentally sound manner. The largest portion of materials-related research is carried out through the Division of Materials Sciences.

Basic Energy Sciences carries out basic materials research that underpins the energy mission and Strategic Plan of the Department at all nine DOE multiprogram laboratories, two single program laboratories and one specific-mission laboratory. The multiprogram laboratories are Argonne National Laboratory, Brookhaven National Laboratory, Idaho National Engineering Laboratory, Lawrence Berkeley National Laboratory, Los Alamos National Laboratory, Oak Ridge National Laboratory, Pacific Northwest National Laboratory, and Sandia National Laboratories in New Mexico and California. The multiprogram laboratories conduct significant research activities for other DOE programs such as Energy Efficiency, Fossil Energy, Nuclear Energy, Environmental Management and Defense Programs.

The single program laboratories are Ames Laboratory at Iowa State University and the National Renewable Energy Laboratory. The specific-mission laboratory is the Stanford Synchrotron Radiation Laboratory.

The Division of Materials Sciences also funds a program which consists of 50 research projects at the University of Illinois Frederick Seitz Materials Research Laboratory.

DIVISION OF MATERIALS SCIENCES

The Materials Sciences subprogram supports energy related fundamental scientific research in materials and the operation of national scientific user facilities. Specific information on the Materials Sciences sub-program is contained in the DOE publication DOE/ER-0682 Materials Sciences Programs FY1995 (published May 1996). This 157-page publication contains program descriptions for 438 research programs that were funded in Fiscal Year 1995 by the Division of Materials Sciences. Five cross-cutting indices identify all 438 programs according to Principal Investigator(s), Materials, Techniques, Phenomena and Environment. Other contents include identification of the Division of Materials Sciences Staff structure and expertise; a bibliographical listing of 50 scientific workshop, topical, descriptive, Research Assistance Task Force and research facilities reports on select topics that identify materials sciences research needs and opportunities; a descriptive summary of the DOE Center of Excellence for the Synthesis and Processing of Advanced Materials; a descriptive summary and access information on 14 National

Research User Facilities including synchrotron light sources, neutron beam sources, electron beam microcharacterization instruments, materials preparation and combustion research; and an analytical summary of research funding levels.* Limited copies may be obtained by calling (301) 903-3427 and requesting DOE publication DOE/ER-0682.

Materials Science enables technology. The performance parameters, economics, environmental acceptability and safety of all energy generation, conversion, transmission, and conservation technologies are limited by the discovery and optimization of the behavior and performance of materials in these energy technologies. This research seeks to understand the synergistic relationship between the synthesis, processing, structure, properties, behavior, performance in energy technology applications and recycling of materials. Such understanding is necessary in order to develop the cost-effective capability to discover technological and economically desirable new materials and cost-competitive and environmentally acceptable methods for their synthesis, processing, fabrication, quality manufacture and recycling. The subprogram supports strategically relevant basic scientific research that is necessary to discover new materials and processes and to eventually find optimal synthesis, processing, fabricating, and manufacturing parameters for materials. Materials Science research enables sustainable development so that economic growth can be achieved while improving environmental quality.

NATIONAL USER FACILITIES UNDER THE OFFICE OF BASIC ENERGY SCIENCES

The goal of the National User Facilities supported by the Office of Basic Energy Sciences is to provide experimental capabilities, which are not otherwise available in individual laboratories, for the pursuit of research of interest to the Department. These facilities are constructed and operated to support energy-related research, but are available to all qualified scientists based on the merit of their proposed experiments.

There were 4,900 users of Basic Energy Sciences supported National User Facilities in Fiscal Year 1995. These users conducted forefront research in physics, materials sciences, chemical sciences, earth sciences, structural biology, engineering, medical and other sciences. The costs for the construction and the safe, user-friendly operation of these world class facilities are substantially beyond the capability of individual academic and private industrial research laboratories. They are made available to all qualified users from academia, industry, and both DOE and non-DOE government laboratories, most generally without charge for non-proprietary research that will be published in the open literature.

They permit the Nation's science and technology enterprise to have access to research instruments that are required for world-competitive forefront research that would not otherwise be possible. Included amongst the numerous honors and distinctions to the research that has been carried out at the Basic Energy Sciences national user facilities was the 1994 Nobel Prize in Physics, shared by Dr. Clifford G. Shull, who carried out pioneering investigations in neutron scattering at Oak Ridge National Laboratory. All of the Basic Energy Sciences national user facilities have been constructed within cost, on schedule, and with rigorous compliance to all environmental, safety and health regulations.

DIVISION OF CHEMICAL SCIENCES

The Division of Chemical Sciences supports research important to fossil chemistry, combustion, advanced fusion concepts, photoconversion, catalysis, separations chemistry, actinide and lanthanide chemistry, thermophysical properties of complex fluids, nuclear waste processing, and environmental remediation. Research related to materials is carried out in the areas of heterogeneous catalysis, advanced battery technology, and materials precursor chemistry. The operating budget for FY 1995 for materials-related programs was $5,800,000 and was allocated to 43 projects in heterogeneous catalysis, advanced batteries and materials precursor chemistry.

The program in catalysis emphasizes fundamental chemical, physical, materials and engineering aspects related to catalytic chemistry. Research into fundamental aspects of heterogeneous catalysis overlaps in several areas with complementary efforts in the Division of Materials Sciences. Among these areas are the synthesis of oxides having large surface areas and large pore volumes, but fairly small pores. This includes single and mixed oxides which are either crystalline or amorphous. Another area of overlap is the characterization of thin oxide films on metals. These materials not only have important relationships to industrial catalysts but also are intrinsically interesting and allow the types of detailed studies of ceramic type properties normally associated with single crystals. Structural studies on bimetallic crystals as model catalysts constitutes a second area of overlap.

*Operating funds for FY 1995 for the Office of Materials Science were $275,708,000.

This area is closely tied to alloy physics. Finally, the reactive decomposition chemistry of chlorocarbons on single crystals has a strong relationship to corrosion and lubrication.

The Advanced Battery Research and Development program supports research to develop new generic battery technology focused on the non-automotive consumer market with emphasis on improvements in battery size, weight, life, and recharge cycles. Areas of research include materials development and characterization, battery component development and interactions, characterization methodologies, and systems development and modeling. Although both primary and secondary battery systems are considered, the greatest emphasis is placed on rechargeable (i.e., secondary) battery systems. The program covers a broad spectrum of research including investigations of lithium cells, metal hydrides, fundamental studies of composite electrode structures, failure and degradation of active electrode materials, thin-film electrodes, electrolytes, and interfaces. Characterization and methodologies include problems of electrode morphology, corrosion, separator/electrolyte stability, stable microelectrodes, and the transport properties of electrode and electrolyte materials and surface films. Investigations in computational chemistry, modeling, and simulations, including property predictions, phenomenological studies of reactions and interactions at critical interfaces, film formation, phase change effects on electrodes and characterization of crystalline and amorphous materials are also of interest.

Chemical Sciences-supported materials precursor chemistry centers on the chemistry of advanced materials precursors, including the synthesis of novel inorganic and organometallic and polymeric structures which could serve as precursors to ceramics and other advanced materials. The research is represented by the following areas: catalysis to link monomeric/polymer building blocks; the mechanisms of oligomerization steps; electronic theories to predict precursors for new ceramics; emerging advanced materials based on complex oxides; single source precursors to multicomponent oxides; the design of materials with tailored properties; and the synthesis and characterization of complex 3-dimensional structures.

The Division of Chemical Sciences manages several large scientific facilities. Four of these are user-oriented: the Combustion Research Facility at Sandia/California, the High Flux Isotope Reactor at Oak Ridge National Laboratory, the Stanford Synchrotron Radiation Laboratory at Stanford University and the National Synchrotron Light Source at Brookhaven National Laboratory. The National Synchrotron Light Source is operated in conjunction with the Division of Materials Sciences.

For information about specific programs the DOE contact is William S. Millman, (301) 903-3285. The reader also is referred to DOE publication Summaries of FY 1995 Research in the Chemical Sciences (DOE/ER-0144/13 dated September 1995) for summaries of all funded programs, summaries of Small Business Innovation Research programs; and descriptions of major user and other special facilities. Limited copies may be obtained by calling (301) 903-5804.